FOREST4EU

ITHub 4 – Non-Wood Forest Products

FOREST4EU partner: FC.ID
OG: GO-PinusResina
OG's country: Portugal
Type of Innovation: innovation

Identification of compounds of industrial interest

Introduction

The bark of Pinus radiata is an under-utilized forest residue that is renewable, abundant and has the potential to become a source of sustainable high-value chemicals. However, the use of this bark within a biorefinery for advanced applications is hindered by its intractable characteristics: high integrity, complex composition, and high heterogeneity. Most of the bark is burnt to provide energy and heat. The bark contains a high portion of phenolic extractives, constituting a potential source of valuable compounds. It also contains the heteropolymer suberin, a source of unique building blocks for developing innovative materials with potential broad bactericidal properties. Removal of phenolic extractives and suberin from bark simplifies down-streaming pulping processing of bark's lignocellulosic part.

Methodology and results

The GO implemented an effective green strategy to sequentially extract the lipophilic bark constituents and suberin, exploring scCO$_2$ (40, 50 or 60 $^{\circ}$C / 200, 350 or 500 bar) and a biocompatible ionic liquid catalyst. The obtained scCO$_2$ extracts had similar diversity of lipophilic compounds and predominantly contained resin acids. Further extraction of the scCO$_2$ extracted bark yielded suberin amounts of 2.25% wt. The bark's suberin structure shows archetypal chemical features yet has an idiosyncratic high abundance of alkanoic acids, which is not common in most sources. The findings of this opening bark biorefinery study deserve further development and complementary techno-economic analyses to secure new value chains for the bark's major lipophilic compounds consisting of resin acids and bark suberin

Lessons learned

The amount of underused bark globally is impressively large. The United Nations Food and Agriculture Organization (FAO) estimated that in 2020, round wood production was 3.97 billion m^3, with a growth rate of 5.8% since 2015 (Food and Agriculture Organization, 2018). Considering a 10% bark by wood mass, it has been estimated that more than 190 million tons of pine bark are produced annually. This study demonstrated the dual potential of Pinus radiata bark for sequential recovery of scCO soluble constituents (up to 5.2% wt) and cell wall polymer suberin (2.25% wt). Using green solvents in a multistep approach is essential to creating sustainable bark biorefineries, with two "state of the art" green technologies. The potential to convert underexploited bark residues into a rich portfolio of bio-based compounds through multistep green extraction technologies can directly support the future development of sustainable bark biorefinery concepts (schematically shown in Fig. 6). Importantly, removing the scCO2 soluble constituents and suberin from Pinus radiata bark is expected to produce a material displaying higher thermal sta- bility with further uses in polymer-wood composites (Shebani et al., 2008). Further studies are required to understand the optimal value chains, besides the lignocellulosic-based leftovers after suberin extrac- tion, for the major bark scCO2 soluble compounds: resin acids, and bark suberin.

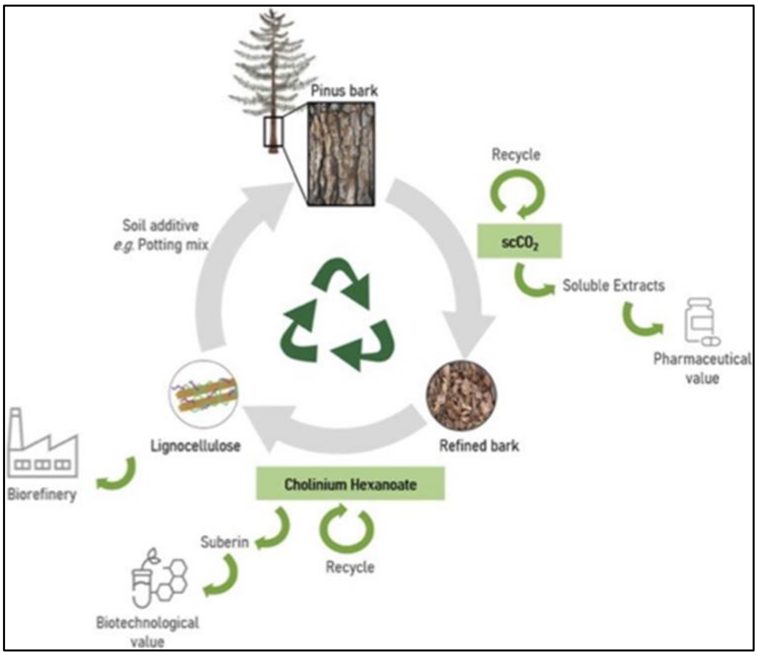

Figure 1. Schematic model of a potential sustainable bark biorefinery

The information presented in this factsheet was developed by the FOREST4EU partner, drawing on the innovations and knowledge generated by the indicated operational group with their explicit authorization.

Further information

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